HOT SPRAY THERMOPLASTIC PAVEMENT MARKING MSP-94-07E

1.0 Description. This specification covers the furnishing and application of a thermoplastic pavement marking material formulated with alkyd resin and intermix beads, and applied by the hot spray process at a 30 (0.75), 45 (1.15) or 60 (1.50) mil (mm) thickness.

1.1 Unless otherwise stated, specification section references are from the version in effect at the time of this contract of the Missouri Standard Specifications for Highway Construction and its supplements.

2.0 Materials.

2.1 Thermoplastic Material. The thermoplastic material, when melted and ground to various finenesses as listed below, shall exhibit leachable lead and chromium levels no greater than 4.0 ppm when tested by the Toxicity Characteristic Leaching Procedure (TCLP, USEPA Method 1311/6010). TCLP leachability testing shall be performed at the following levels of fineness:

Coarse Grind	passing 3/8 inch (9.5 mm)and retained on 1/4 inch (6.3 mm) sieve
Medium Grind	passing # 8 (2.36 mm) and retained on # 20 (6.3 mm) sieve
Fine Grind	passing # 30 (600 µm) sieve

2.1.1 Binder. The binder shall consist of a mixture of synthetic alkyd resins, at least one of which is solid at room temperature. The total binder content of the thermoplastic compound shall be well distributed through the compound. The binder shall be free from all foreign objects or ingredients that would cause bleeding, staining or discoloration. The binder shall be 25 percent minimum by weight of the thermoplastic compound.

2.1.2 Pigment.

2.1.2.1 White. The pigment used for the white thermoplastic compound shall be a high-grade pure (minimum 93 percent) titanium dioxide (Ti02). The white pigment content shall not be less than 10 percent by weight and shall be uniformly distributed throughout the thermoplastic compound.

2.1.2.2 Yellow. The pigments for the yellow thermoplastic compound shall be nontoxic, heat resistant, and color-fast yellows, golds and oranges, which shall produce a compound meeting the requirements of Federal 595 Color No. 33538.

2.1.3 Filler. The filler to be incorporated with the resins as a binder shall be a white calcium carbonate, silica, or an approved substitute. Any filler which is insoluble in 6N hydrochloric acid shall be of such particle size as to pass a No. 100 (150 µm) sieve.

2.1.4 Mixed Compound.

2.1.4.1 The mixed thermoplastic compound, after heating for 4 hours ± 5 minutes at 375 ± 3 F (190.6± 2 C) and cooled at 77 F (25 C) shall meet the following requirements for daylight reflectance and color, when tested using a color spectrophotomer with 45 degree circumferential/0 degree geometry, illuminant C, and 2 degree observer angle. The color

instrument shall measure the visible spectrum from 380 to 721 nm with a wavelength measurement interval and spectral bandpass of 10 nm.

White: Daylight Reflectance (Y) 75 percent minimum

*Yellow: Daylight Reflectance (Y) 42 - 59 percent

*Shall match Federal 595 Color No. 33538 and chromaticity limits as follows:

x	0.470	0.510	0.485	0.530
y	0.455	0.485	0.425	0.456

2.1.4.2 Specific Gravity. The specific gravity of the thermoplastic material shall not exceed 2.15.

2.1.4.3 Softening Point. After heating the thermoplastic material for 4 hours ± 5 minutes at 375 ± 3 F (190.6 ± 2 C) and testing in accordance with ASTM E28, the material shall have a minimum softening point of 180 F (82.2 C) as measured by the ring and ball method.

2.1.4.4 Tensile Bond Strength. After heating the thermoplastic material for 4 hours ± 5 minutes at 375 F (190.6 C), the tensile bond strength to unprimed, sandblasted portland cement concrete block, 0.0625 in. (1.587 mm) thick film drawdown at 375 F (190.6 C), test at 75 ± 2 F (23.0 ± 1 C) shall exceed 180 psi (1.24 MPa) when tested in accordance with ASTM D 4796.

2.1.4.5 Impact Resistance. After heating the thermoplastic material for 4 hours ± 5 minutes at 375 ± 3 F (190.6 ± 2 C) the impact resistance shall be a minimum of 50 inch-pounds (5.65 Newton-meters) with no cracks or bond loss when 0.0625 in. (1.587 mm) thick film drawdown is made at 375 F (190.6 C) on an unprimed, sandblasted portland cement concrete block, male indentor 5/8 in. (15.875 mm), no female Die, tested at 75 ± 2 F (23.9 ± 1 C) when tested in accordance with ASTM D 2794.

2.1.4.6 Yellowness Index. The white thermoplastic material shall not exceed a yellowness index of 12 when tested in accordance with ASTM D 1925.

2.1.5 Packaging.

2.1.5.1 The thermoplastic material shall be packaged in suitable containers which will not adhere to the product during shipment and storage. The container of thermoplastic material shall weigh approximately 50 lbs (22 kg). Each container shall designate the color, type of binder, spray and user information. The label shall warn the user that the material shall be heated in the range of 350 - 425 F (177 - 218 C).

2.1.5.2 Each package shall be marked with the name of the manufacturer, the type of material, the month and year the material was packaged and lot number. The letters and numbers shall be a minimum of 1/2 in. (12 mm) in height.

2.2 Glass Beads.

2.2.1 Intermix Beads. Both intermix and drop-on beads shall meet Sec 1048.3.6, except that intermix beads shall be uncoated. Intermix beads shall be uniformly mixed throughout the thermoplastic material at the rate of not less than 30 to 35 percent by weight (retained on the No. 100 (150 µm) sieve of the thermoplastic material.

3.0 Certification and Acceptance.

3.1 The contractor shall furnish a manufacturer's certification to the engineer, for each lot furnished, certifying that the material supplied conform to all requirements specified. The certification shall include or have attached typical results of required tests.

3.2 Acceptance of the material will be based on the manufacturer's certification and upon the results of such tests as may be performed by the engineer.

4.0 Construction Requirements.

4.1 Equipment. All equipment for application of thermoplastic marking materials shall be of such design and maintained in such condition as to properly heat, mix and apply the materials.

4.1.1 Melting Kettle. The melting kettle shall be capable of heating the thermoplastic material to its recommended application temperature without scorching and shall be capable of maintaining that temperature. The heating kettle shall have a heat transfer medium and the flame shall not come in direct contact with the material container surface. A temperature gauge shall be visible on the outside of the kettle to indicate the temperature of the thermoplastic material. The melting kettle shall have a continuous mixer or agitator capable of thoroughly mixing the material at such a rate as to maintain homogeneity of material and uniformity of temperature throughout.

4.1.2 Thermoplastic Dispensing Devices. The equipment shall be capable of applying molten thermoplastic material at the temperature recommended by the manufacturer of the thermoplastic material in lines from 4 inches (100 mm) to 12 inches (300 mm) wide at the specified thickness. Dispensing devices shall be of the spray type.

4.1.3 Glass Bead Dispenser. The thermoplastic dispenser shall be equipped with a drop-on type glass bead dispenser. The glass bead dispenser shall be located so as to drop the glass beads immediately after the molten thermoplastic material is applied. The glass bead dispenser shall be adjustable to regulate flow of the beads and shall uniformly dispense the glass beads over the entire width of the line.

4.2 Surface Preparation. The pavement surface on which the thermoplastic material is to be placed shall be clean and dry. Pavement surfaces shall be inspected for cleanliness, and any dirt, debris or other contaminants on the surface to be marked shall be removed. On concrete surfaces, the curing compound shall be removed by an approved blasting method.

4.3 Temperature Limitations. The pavement surface where the thermoplastic material is to be placed shall have a minimum temperature of 60 F (15.6 C). The air temperature shall be at least 50 F (10 C) during marking operations. The pavement surface temperature and air temperature shall be determined before the start of each day of marking operation and at any other time deemed necessary by the engineer. Temperatures are to be obtained in accordance with MoDOT Test Method T20.

4.4 Primer Application. A primer is not required on new bituminous surfaces unless recommended by the manufacturer of the thermoplastic material. If primer is recommended it shall be applied and cured in accordance with the recommendations of the manufacturer of the thermoplastic material.

4.5 Thermoplastic Application. The thermoplastic marking material shall be sprayed onto the pavement surface.

4.5.1 The temperature of the thermoplastic material at the time of application shall be a minimum of 350 F (177 C) and a maximum of 425 F (218 C). The temperature of the thermoplastic material shall be checked at the point of deposition with a calibrated thermometer at the beginning of each day's marking, after material is added to the dispensing device, after delays in the marking operation, and any time deemed necessary by the engineer.

4.5.2 Pavement striping shall comply with the standard striping practices as shown on the plans. The contractor shall begin center line and lane line striping at the beginning of the last existing 10-foot (3 m) stripe in order to maintain a 40-foot (12 m) cycle along the entire pavement.

4.5.3 Finished markings shall have well defined edges and lateral deviation shall not exceed one inch (25 mm) in 100 feet (30 m). The thickness of thermoplastic markings shall be within ± 5 mils (±120 µm) of the specified thickness. The thickness will be measured as a wet film except the engineer may measure cured film by placing a tape or other bond breaker prior to placing the thermoplastic material and then removing a section of cured line and measuring thickness.

4.5.4 Damage to pavement marking caused by the contractor's operation shall be repaired or replaced at his expense.

4.6 Glass Bead Application. The drop-on glass bead shall be mechanically deposited on the molten thermoplastic line immediately after placement of the thermoplastic at the rate of at least 10 pounds per 100 square feet (0.5 kg per square meter) of line. The glass beads shall not be dropped at the point of deposition of the thermoplastic or ahead of that point. The beads shall adhere to the cured thermoplastic or all marking operations shall cease until corrections are made.

4.7 Workmanship. The applied thermoplastic markings should be inspected continually for overall workmanship. Markings shall have clean cut edges. The glass beads shall appear uniform on the entire marking surface. Adhesion to the pavement surface shall be checked with a stiff putty knife or similar instrument. The marking should not be removable from a concrete surface. The marking can be removed from a bituminous surface, however, residue of the bituminous substrate shall be stuck to the marking material.

4.7.1 If the thermoplastic line does not provide initial nighttime reflectivity or, if the marking does not have the required minimum thickness, the contractor shall at his expense, apply additional thermoplastic material to the total thickness specified to the surface of the deficient portion of the marking. If the marking does not meet the required color, the contractor shall at his expense remove the marking in a manner approved by the engineer and re-apply the material. If the markings do not comply with the specifications for any other reason, the engineer may require complete removal or correction at the contractor's expense.

5.0 Method of Measurement.

5.1 Measurement of thermoplastic pavement marking will be made to the nearest 10 linear feet (3 m) from point of beginning to point of ending for each line. Where intermittent lines are specified, deduction will be made for the gaps in the striping.

5.2 Measurement of arrows, words, symbols or markings other than lines will be made per each.

5.3 Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity.

6.0 Basis of Payment. The accepted quantity of thermoplastic pavement marking will be paid for at the contract unit price.